KSMTE ICMTE 2022 Poster Template

Poster size : A0 (841mm × 1189mm)

Title : (Font size Bold 65)

Author's Name : A-A Lee[1#], B-B Lee[2], C-C Lee[2] (Font size 36)

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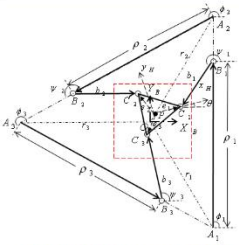
Introduction (Font size 36)

◆ Workspace of planar 3-DOF parallel manipulator

- Parallel manipulator : High Precision, High Stiffness
  Light weight, Stable operation
  Limited Workspace
- Maximizing the workspace of a planar 3-DOF parallel manipulator on 100 x 100 mm² size
- Kinematics, Design Optimization, Control and Experiments

Position Kinematics



Schematic Diagram of 3-DOF parallel manipulator

$$ {}^{B}\underline{C}_i = {}^{B}\underline{P}_H + {}^{B}_{H}R\,{}^{H}\underline{C}_i = {}^{B}\underline{A}_i + \rho_i e^{i\theta_i} + b_i e^{i\varphi_i}, \quad i = 1,2,3 $$

$$ \rho_i = M_i \pm N_i $$

Where,

$$ M_i = ({}^{B}x_{Ci} + {}^{B}x_{Ai})\cos\phi_i + ({}^{B}y_{Ci} - {}^{B}y_{Ai})\sin\phi_i $$

$$ N_i = \sqrt{b_i^2 - S_i^2} $$

$$ S_i = ({}^{B}x_{Ci} - {}^{B}x_{Ai})\sin\phi_i - ({}^{B}y_{Ci} - {}^{B}y_{Ai})\cos\phi_i $$

- B is fixed on base and H is moving platform
- Simulation by MATLAB™

Design Optimization

- *maximize* $f(x)=W$ *over* $x = [\,e \;\; r \;\; b\,]^T$

Subject to : $g_1 : 0 \le \rho_i \le \sqrt{3}r$

$g_1 : b + e = r/2$

$x_{lb} \le x \le x_{ub}$

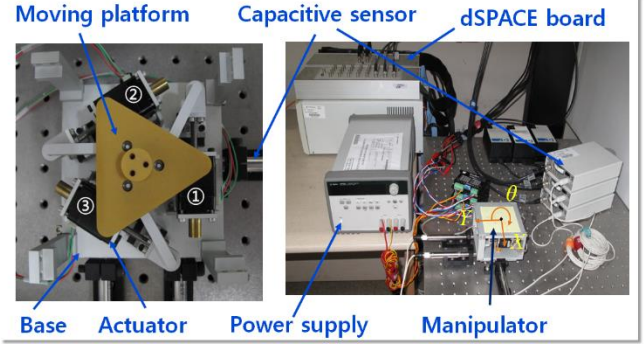
Design variable	e	r	b
x_{lb} [mm]	0	59	35
x_{ub} [mm]	10	61	45

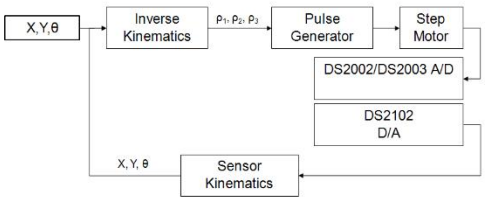
Bounds of the design variables

Objective	Design variable		
W (Workspace)	e [mm]	r [mm]	b [mm]
0.2608	**9**	**59**	**41**

Optimization results

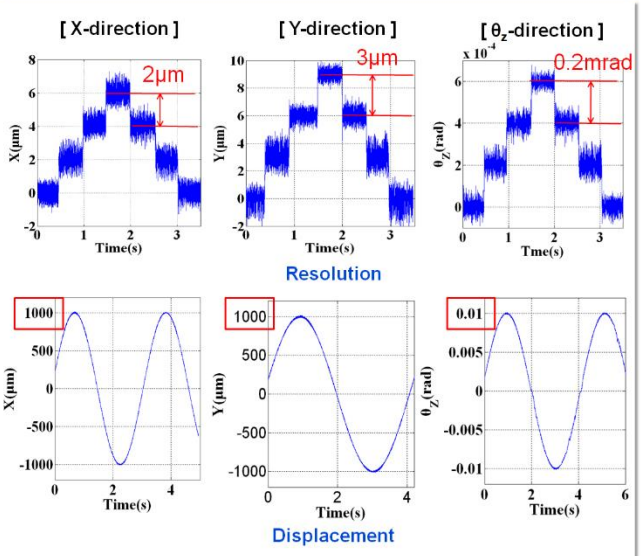
Experiments





Block Diagram for the Closed-loop Control

Experiment results



- Resolutions of X and Y axis translation are 2,3 μm
- Resolution of Z axis rotation is 0.2mrad (0.0115°)

Conclusion

◆ Design and Control of proposed 3-DOF manipulator

- The manipulator was designed with design optimization
- Inverse kinematics of the mechanism was verified through the closed-loop control
- Workspace verification should be carried out in the future

Acknowledgement

◆ This work was supported by the Industrial Strategic technology development program, Development of next generation multi-functional machining systems for eco/bio components

REFERENCES

(1) C. M. Gosselin, S. Lemieux and J.-P. Merlet, 1996, "A new architecture of planar three-degree-of-freedom," Proceeding of Int. Conference on Robotics and Automation, Vol.4, pp. 3738~3743.